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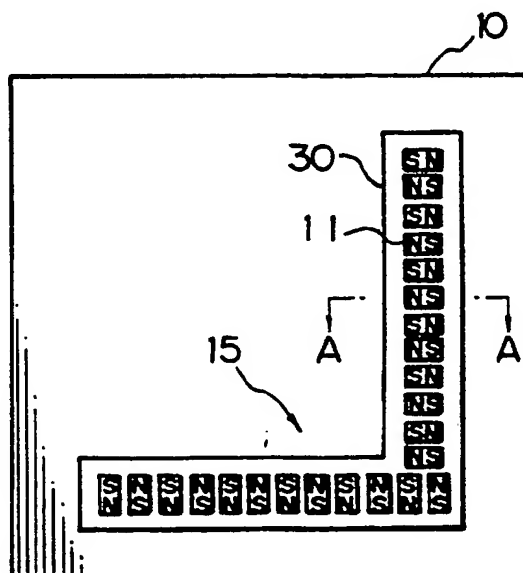
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D-8000 München 81(DE)**(54) **Forming method of patterned coating.**

(57) The invention relates to a method of forming a patterned coating upon a surface of a substrate (10). A plurality of separated magnetic elements (11) are arranged side by side forming an arrayed module (15) of the elements (11). Then, the model (15) is brought in close vicinity of the reverse side of the substrate (10). And then, magnetic paint containing powdery magnetic material is applied to the surface of the substrate (10) to make a wet film thereon. Finally, the wet film is hardened through a baking or drying. A continuous pattern corresponding to the configuration pattern of the module (15) appears on the surface of the substrate (10). Alternatively, a coated substrate may be introduced into a magnetic field while a wet film of magnetic paint is carried thereon.

Fig.1**EP 0 406 667 A1****BEST AVAILABLE COPY**

FORMING METHOD OF PATTERNED COATING

This invention relates to a forming method of patterned coating upon miscellaneous surfaces, especially a method for illustrating various letters, characters, or figures upon a coated surface in a different tone of configuration from adjacent areas.

In order to illustrate miscellaneous patterns on a coated film, various methods have been proposed including; a method of additional coating utilizing a masking template for covering a portion of a pre-coated surface; a method of sticking colored sheets or colored tapes on a pre-coated film; and a method of embossing patterns on an under layer or substrate before a color coating. However, these methods have specific drawbacks of the following: the masking template needs time-consuming sticking work and stripping work; a stepped irregularities are produced between the first coating film and the second coating film; the patterns made by sheets or tapes tend to be erased within a short period; or embossing patterns cannot render an explicit configuration.

In Japanese Patent Public Disclosure No. 175670/1988, there is disclosed a forming method of patterned coating utilizing a magnetic force. According to this method, at first a liquid coating material containing powdery magnetic materials, such as nickel, stainless steel or iron, is applied to a natural surface or pre-coated surface of the object. Then, while the coating material keeps its fluidity, a magnet is brought near. Thus, the powdery magnetic materials, which are uniformly dispersed within the liquid coating material, move along magnetic force lines within the coating film, thereby producing a configuration pattern different from adjacent areas.

In Japanese Patent Public Disclosure No. 10376/1982, there is disclosed a manufacturing method of metallic plate having a patterned coating. According to this method, at first a liquid paint containing an iron oxide is coated upon a metallic plate. Then, a magnetic pole is brought near the coated film, so that a pattern corresponding to the magnetic pole appears upon the film. And then, a baking treatment is applied to the coated film to finish the coated layer.

However, it has been found that an ordinary magnetic piece having a dimension of several inches or centimeters cannot produce a desirable explicit configuration pattern. This kind of magnetic piece has special properties that in the vicinity of both ends magnetic forces are relatively strong but at the intermediate portion magnetic forces are poor. As a result, the configuration made by an ordinary magnetic piece is liable to become a non-readable vague pattern.

It is an object of the present invention to overcome the above drawbacks of the conventional forming method and to provide an explicit pattern within a coating film object utilizing a magnetic force. Another object of the present invention is to provide a forming method capable of illustrating miscellaneous patterns without being restricted by the shape of the magnet itself.

According to the first aspect of the invention, there is provided a method of forming a patterned coating upon a surface of a substrate, comprising the steps of; preparing a plurality of separated magnetic elements to be arranged side by side into an arrayed module of the elements, bringing said module in close vicinity of a reverse side of a substrate, applying magnetic paint containing powdery magnetic material upon the surface of said substrate to make a wet film thereon, and hardening the wet film through a baking or drying, thereby providing a continuous pattern corresponding to the configuration pattern of said module upon the surface of the substrate.

In this method, at first an imaginary chain of magnetic force lines is formed along the module of the elements, and then a substrate is introduced into the magnetic field and exposed to the magnetic power. When magnetic paint containing powdery magnetic material is sprayed to the surface of the substrate, magnetic fine particles instantly begins to move within the wet film toward the direction of the magnetic force lines. As the wet film loses its fluidity, the movements of the magnetic material slow down and terminate near the magnetic force lines. Thus, an explicit continuous pattern corresponding to the configuration pattern of the module appears in a hardened film. The appearance of the pattern is not always identical with the configuration pattern of the magnetic chain, since magnetic force lines vary depending upon the directions of the magnetic elements, especially upon the positions of North magnetic poles and South magnetic poles carried on the elements. It should be appreciated that a delicate pattern can be illustrated in the hardened film by changing the direction of each magnetic element.

Referring to the magnetic elements, which may be carried on a plastic sheet or metallic plate, a metallic magnet, ferrite magnet, sintered magnet or flexible magnet may be used depending upon the shape or magnetic properties. Preferably, these magnetic elements are formed through a moulding process into a relatively small piece having a rectangular, triangular, polygonal or circular configuration. By a combination of several configurations, any pattern can be illustrated.

According to the second aspect of the invention, there is provided a method of forming a patterned coating upon a surface of a substrate comprising the steps of; preparing a plurality of separated magnetic elements to be arranged side by side into an arrayed module of the elements, applying magnetic paint containing powdery magnetic material upon a surface of a substrate to make a wet film thereon, bringing said module toward the surface or reverse side of said coated substrate in close vicinity of said wet film while the wet film keeps its fluidity, and hardening the wet film through a baking or drying, thereby providing a continuous pattern corresponding to the configuration pattern of said module within the magnetic paint film.

In this method, a module of magnetic elements and a magnetic paint coated substrate are prepared in separately. And then, the magnetic paint coated substrate is introduced into a magnetic field produced by the module while the wet film of magnetic paint keeps its fluidity. As the coated substrate is inserted into the magnetic field and exposed to the magnetic power, magnetic fine particles instantly begin to move within the wet film toward the direction of the magnetic force lines. As the wet film loses its fluidity, the movements of the magnetic material slow down and finally terminate near the magnetic force lines. Thus, an explicit continuous pattern corresponding to the configuration pattern of the module appears in the magnetic paint film. These characteristics of the invention are effected by the module of the magnetic elements, which are closely disposed in order to maintain magnetic forces therebetween.

In a preferable embodiment of the invention, each magnetic element comprises a rectangular or circular metallic plate having a North magnetic pole and a South magnetic pole situated at the opposite edges thereof, and adjacent magnetic elements are disposed such that the North magnetic pole of one element is positioned in close vicinity of the South magnetic pole of the other element.

In a further preferable embodiment of the invention, the magnetic elements comprise bar-shape or U-shape magnets each having a North magnetic pole and a South magnetic pole situated at the opposite edges thereof, and each magnet is perpendicularly disposed to the substrate.

In a further preferable embodiment of the invention, the magnetic elements are filled up within a rubber or plastic sheet in a plurality of striped patterns.

As an example of the magnetic powder to be contained in the magnetic paint, stainless steel powder, ferrous powder, Fe_3O_4 coated mica powder, alloy powder containing iron, cobalt and nickel, magnetic iron oxide coated resin particles or the

like may be utilized as far as it can move within the wet film or change its direction under the influence of a magnetic force. Of course, it should be contained and dispersed uniformly in magnetic paint. The aforementioned Fe_3O_4 coated mica powder is well known as a nacreous pigment of paint. It should be noted that an ordinary pigment can be utilized in the present invention as far as it has a property to be influenced by a magnetic force.

As an example of the magnetic paint to be applied to the surface of the substrate, any kind of ordinary paint can be utilized as far as it can form a cured film after having finished a series of processes including a coating under a fluid condition and a baking or drying to harden the film. The magnetic paint includes, other than the magnetic powder, a pigment, vehicle resin, curing agent, solvent or the like. The containing ratio of the magnetic powder relative to the magnetic paint is determined in a range such that an explicit pattern appears under the influence of a magnetic force. According to an experiment, the ration is preferably more than 0.1 percent of the magnetic paint by weight. The magnetic paint may be selected from an ordinary type which is hardened by a baking process or air drying process under the ambient temperature.

The coating system can be selected from the following: (1) 1-coat finishing system in which magnetic paint is coated upon a substrate thereby making a single coating layer. (2) 2-coat 1-bake finishing system in which at first magnetic paint is coated upon a substrate, and then clear paint is applied on it by wet on wet process, and finally both layers are cured by a baking.

In an extended practical mode, this invention can apply to miscellaneous coating processes including more complicated coating steps, as far as the wet film is magnetically accessible from outside. For example, after a base color coating is formed upon a surface of a substrate as a first-coated layer, magnetic paint can be applied to the surface as an additional ornamental layer. When magnetic elements are brought near the ornamental layer, some portions of the ornamental layer becomes thinner under the influence of a magnetic force. As a result, some portions of the first-coated layer appear and provide delicate color patterns which have not yet been illustrated.

It is also possible to apply clear paint over the completed magnetic powder layer in order to protect the patterned surface from an attack.

As an example of the substrate, non-magnetizable material such as synthetic resin, rubber, ceramic or aluminum plate is preferable, since these materials do not affect the magnetic force of the magnetic element. Of course, under the restricted condition such that the substance is rela-

tively thin, some kinds of magnetizable materials may be used. Especially, in the case that the magnetic elements are brought near toward the surface of the substrate, the influence is small. However, such approaching operation toward the surface is not desirable because a collision may happen between the wet film and the magnetic elements, resulting in a destruction of the coated layer.

During the process of the present invention, the module of the magnetic elements should be supported on a guiding device, which may comprise a supporting rail, handling arm or similar member. When the magnetic elements are stucked together by a plastic tape, attention should be paid to the temperature during a baking process.

The forming method of the invention can be preferably utilized for illustrating various letters, characters, or figures upon a coated surface. In addition, the method can be utilized for representing a repetitive pattern over a large area of the substrate. In this case, a plurality of magnetic modules are prepared or a single module is repeatedly used.

Other features and advantages of the invention will become apparent from a reading of the specification, when taken in conjunction with the drawings, in which like reference numerals refer to like elements in the several views.

FIG. 1 is a plan view of a reverse side of a substrate to be coated utilizing the method of the present invention.

FIG. 2 is a sectional view taken along the line A-A in FIG. 1.

FIG. 3 is a plan view of the surface of the substrate which is coated by the method of the present invention.

FIG. 4 is a sectional view of an alternative embodiment similar to FIG. 2.

FIG. 5 is a plan view illustrating an alternative module of multi-pole type magnetic elements.

FIG. 6 is a perspective view of a modified module utilizing column-type magnetic elements.

FIG. 7 is a plan view illustrating an arrangement of circular magnetic elements.

FIG. 8 is a plan view illustrating an alternative arrangement of the magnetic elements in FIG. 7.

FIG. 9 is a perspective view of a modified arrangement utilizing a combination of several types of magnetic elements.

FIG. 10 is a perspective view of a modified arrangement utilizing a combination of bar-shape and U-shape magnetic elements.

FIG. 11 is a plan view illustrating characters represented by the method of the present invention.

Referring to FIGS. 1 to 3, there is shown a first embodiment utilizing the method of the present

invention. As shown in FIG. 1, to the reverse side of the substrate 10 to be coated, is stucked an arrayed module 15 which comprises a plurality of rectangular magnetic elements 11 supported on a sticking tape 30. Each of the magnetic elements 11 carries a North magnetic pole and a South magnetic pole at the opposite edges. The magnetic elements 11 are disposed side by side, and adjacent elements 11 are disposed such that the North pole of one element is positioned in close vicinity of the South pole of the other element, and that the South pole of the one element is positioned in close vicinity of the North pole of the other element. Accordingly, strong magnetic force lines are produced between the elements, of course in an imaginary form.

FIG. 2 shows a relationship among the coated paint 20, the substrate 10, the magnetic element 11 and the sticking tape 30. It should be noted that the element 11 is firmly stucked to the substrate 10 by the sticking tape 30.

FIG. 3 shows a surface which has been coated with magnetic paint. In this embodiment, after the module 15 of magnetic elements is stucked to the reverse side of the substrate 10, magnetic paint is sprayed on the surface. Since an imaginary chain of magnetic force lines is formed along the module 15, as soon as the magnetic paint is thrown into the magnetic field and applied to the surface of the substrate, magnetic fine particles instantly begin to move within a wet film of the magnetic paint toward the direction of the magnetic force lines. As the wet film loses its fluidity, the movements of the magnetic material slow down and finally terminate near the magnetic force lines. Thus, a transitional area 24 in which a color tone is different from that of the adjacent area appears on the surface of the substrate 10. The configuration of the area 24 is corresponding to the configuration pattern of the module 15. It should be noted that the configuration of the pattern 24 is not identical with the configuration pattern of the separated magnetic elements 11.

Subsequently to the pattern making process, the surface of the substrate 10 is subjected to a baking process or drying process for stabilizing the pattern. After the stabilization, the transitional area 24 grows an explicit pattern. This pattern is essentially an transitional tone area among the coated layer, so that the surface of the substrate 10 remains flat free from irregularities. This pattern does not vanish as long as the coated layer remains on the surface. Further, this pattern does not vary under the influence of a sunlight.

FIG. 4 shows an alternative embodiment of the pattern making process. At first, an appropriate pre-treatment is applied to the surface of the substrate 40, and then a primer layer 41 is formed by spraying of liquid paint to the surface. From this

stage, this invention is applied to the pre-coated surface. In the same way as the aforementioned process referring to FIGS. 1 to 3, the module of metallic elements 11 is stuck to the reverse side of the substrate 40 accompanied by a sticking tape 30. Subsequently to the primer layer 41, a magnetic paint layer 42 is formed. While magnetic paint is sprayed upon the primer layer 41 to make a wet film thereon, the aforementioned pattern is formed within the magnetic paint layer 42. Further, subsequently to the magnetic paint layer 42, a final coating layer 43 of clear paint is formed. After the module of the magnetic elements is removed therefrom, these layers 42 and 43 are subjected to a baking or drying step. In this embodiment, it is preferable to use strong magnetic elements having strong magnetic forces, since the primer layer 41 is intervening between the substrate and the magnetic paint layer.

FIG. 5 shows an alternative module 55 consisting of right and left multi-pole type magnetic elements 51, 52 and so on. Adjacent magnetic elements 51 and 52 are disposed such that each of the North magnetic poles of the element 51 is positioned in close vicinity of the South magnetic pole of the element 52, and that each of the South magnetic poles of the element 51 is positioned in close vicinity of the North magnetic pole of the element 52. According to this arrangement, the magnetic force lines M are directed along the longitudinal direction of the module 55, so that a pattern revealed on the surface of the substrate becomes a continuous I-shape pattern having a relatively large width.

FIG. 6 shows a modified module 63 utilizing column-type magnetic elements 61, 62 and so on. This module 63 is used to illustrate a C-shape pattern on the surface of the substrate 10. Adjacent magnetic elements 61 and 62 are disposed such that the North magnetic pole of one element is positioned in close vicinity of the South magnetic pole of the other element. According to this arrangement, the magnetic force lines are directed along the centerline of the module 63, so that a pattern revealed on the surface of the substrate 10 becomes a continuous C-shape pattern. It should be noted that the revealed pattern is not a dotted pattern of the column-type magnets.

FIG. 7 shows a modified arrangement of magnetic elements. The module 66 comprises a plurality of circular magnetic elements 64, 65 and so on. As compared with the arrangement in FIG. 6, each of the magnetic elements is rotated in a right angle. Adjacent magnetic elements 64 and 65 are disposed such that the North magnetic pole of one element is positioned in the same lateral side as the South magnetic pole of the other element, so that two parallel magnetic force lines M are formed

on the upper space of the module 66. According to this arrangement, the magnetic force lines are directed along the lateral sides of the module 66, so that a pattern revealed on the surface of the substrate becomes an arcuate pattern, which is not identical with the dotted pattern of the circular magnets.

FIG. 8 shows an alternative arrangement of the magnetic elements in FIG. 7. In this arrangement, adjacent magnetic elements 67 and 68 of the module 69 are disposed such that the North magnetic pole of one element is positioned in the same lateral side as the North magnetic pole of the other element, and that the South magnetic pole of one element is positioned in the same lateral side as the South magnetic pole of the other element. According to this arrangement, the magnetic force lines M are directed in a cross-over form due to a repelling force between the same magnetic poles, resulting in random lines. However, due to this random magnetic force lines, a delicate complicated pattern similar to an arcuate form appears on the surface of the substrate. Of course, this pattern is not identical with the dotted pattern of the circular magnets.

FIG. 9 shows a modified arrangement utilizing a combination module 75 including two types of magnetic elements. One type consists of ordinary two-pole magnetic elements 61 and 62, and the other type consists of multi-pole magnetic elements 71 and 72. As a result of the combination, the module 75 can reveal a continuous H-shape pattern upon the surface of the substrate.

FIG. 10 shows a modified arrangement utilizing a combination module 85 including U-shape magnets 81, 82 and bar-shape magnets 83, 84. In these kinds of magnets or magnetic elements, the North magnetic pole and the South magnetic pole are positioned at their distal ends. As shown in FIG. 10, each magnet is perpendicularly disposed to the substrate 10. The upper ends of the magnets are arranged in a grid form, so that the combination module 85 reveals a grid form pattern upon the surface of the substrate 10.

FIG. 11 shows sample characters represented by the method of the invention. In this embodiment, magnetic elements are filled up within a rubber or plastic sheet in a plurality of striped patterns.

In an application of the method of the invention, a North magnetic pole and a South magnetic pole are easily detected by approaching a compass to the object. Therefore, the miscellaneous arrangements as shown in the drawings are easily prepared and utilized. The magnetic elements can be connected by a sticking tape or similar parts. Since the module of the magnetic elements can be removed easily, after the usage, no damage is

occurred upon the substrate.

Improvements and modifications may be made to the present invention without departing from the scope or spirit thereof.

Claims

1. A method of forming a patterned coating upon a surface of a substrate, comprising the steps of; preparing a plurality of separated magnetic elements to be arranged side by side into an arrayed module of the elements, bringing said module in close vicinity of a reverse side of a substrate, applying magnetic paint containing powdery magnetic material upon the surface of said substrate to make a wet film thereon, and hardening the wet film through a baking or drying, thereby providing a continuous pattern corresponding to the configuration pattern of said module upon the surface of the substrate.
2. A method of forming a patterned coating upon a surface of a substrate, comprising the steps of; preparing a plurality of separated magnetic elements to be arranged side by side into an arrayed module of the elements, applying magnetic paint containing powdery magnetic material upon a surface of a substrate to make a wet film thereon, bringing said module toward the surface or reverse side of said coated substrate in close vicinity of said wet film while the wet film keeps its fluidity, and hardening the wet film through a baking or drying, thereby providing a continuous pattern corresponding to the configuration pattern of said module within the magnetic paint film.
3. A method of forming a patterned coating as claimed in claim 1, wherein said magnetic elements comprise rectangular or circular metallic plates each having a North magnetic pole and a South magnetic pole situated at the opposite edges thereof, and adjacent magnetic elements are disposed such that the North magnetic pole of one element is positioned in close vicinity of the South magnetic pole of the other element.
4. A method of forming a patterned coating as claimed in claim 2, wherein said magnetic elements comprise rectangular or circular metallic plates each having a North magnetic pole and a South magnetic pole situated at the opposite edges thereof, and adjacent magnetic elements are disposed such that the North magnetic pole of one element is positioned in close vicinity of the South magnetic pole of the other element.
5. A method of forming a patterned coating as claimed in claim 1, wherein said magnetic elements comprise bar-shape or U-shape magnets each having a North magnetic pole and a South magnetic pole situated at the opposite edges there-

of, and each magnet is perpendicularly disposed to the substrate.

6. A method of forming a patterned coating as claimed in claim 2, wherein said magnetic elements comprise bar-shape or U-shape magnets each having a North magnetic pole and a South magnetic pole situated at the opposite edges thereof, and each magnet is approached toward the substrate perpendicularly thereto.

7. A method of forming a patterned coating as claimed in claim 1, wherein said magnetic elements are filled up within a rubber or plastic sheet in a plurality of striped patterns.

8. A method of forming a patterned coating as claimed in claim 2, wherein said magnetic elements are filled up within a rubber or plastic sheet in a plurality of striped patterns.

Fig.1

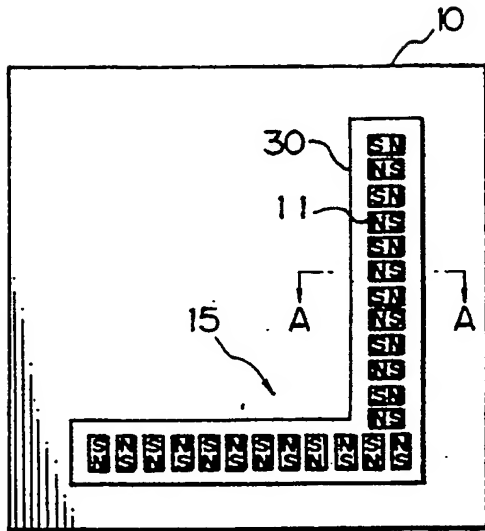


Fig.2

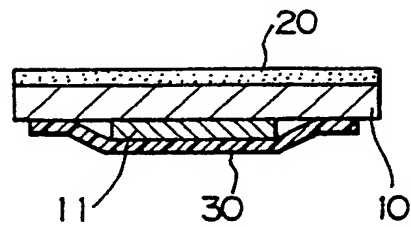


Fig.3

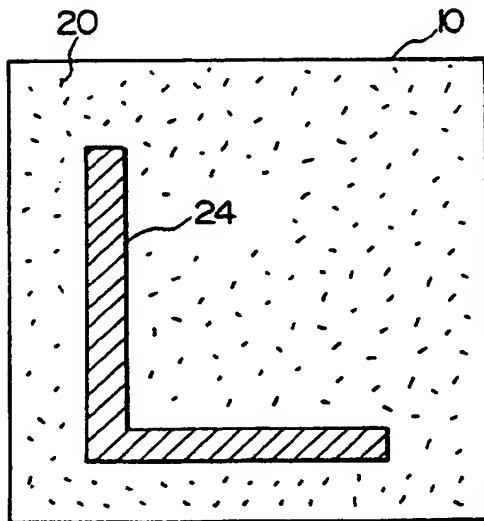
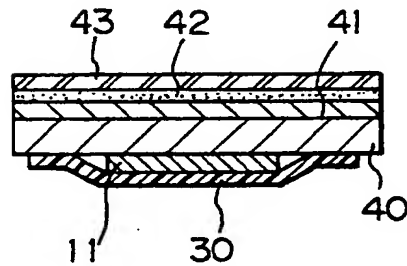


Fig.4



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Fig. 5

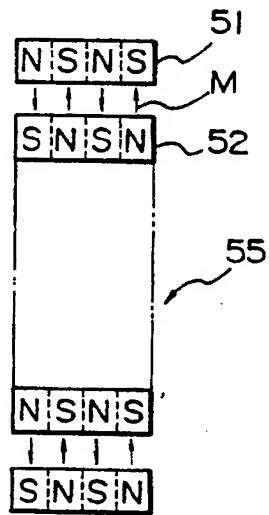


Fig. 6

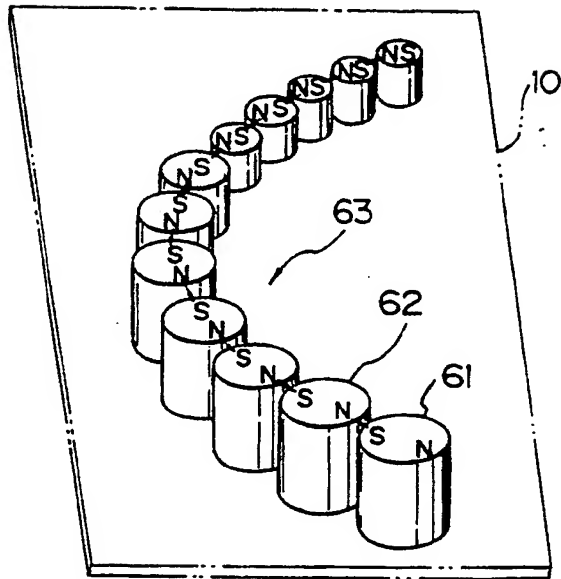


Fig. 7

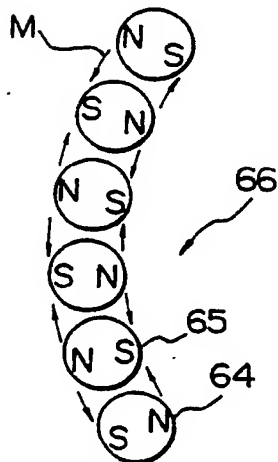
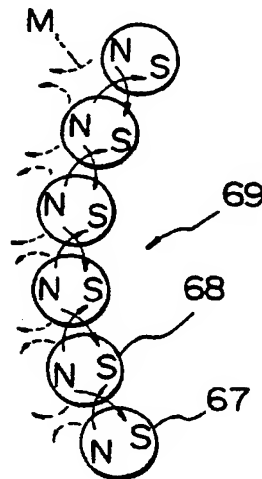


Fig. 8



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Fig. 9

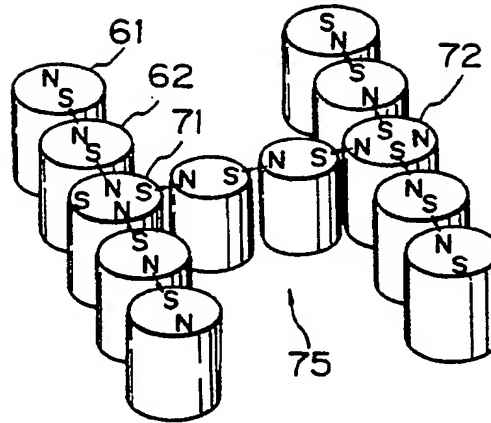


Fig. 10

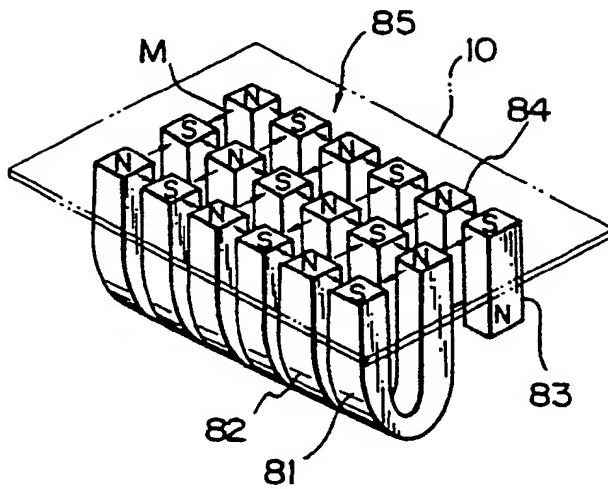


Fig. 11



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DOCUMENTS CONSIDERED TO BE RELEVANT			EP 90112121.0
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE - A - 2 010 831 (MAGNETFABRIK BONN) * Claims; page 4, line 16 - page 5, line 4; fig. 1,2 *	1-4, 7, 8	B 44 C 1/00 B 05 D 5/06 //C 09 D 5/23
D,A	PATENT ABSTRACTS OF JAPAN, unexamined applications, C section, vol. 6, no. 73, May 8, 1982 THE PATENT OFFICE JAPANESE GOVERNMENT page 66 C 101 * Kokai-no. 57-10 376 (NITSUSHIN SEIKOU K.K.) *	1, 2	
D,A	DERWENT ACCESSION NO. 88-244 763; Questel Tele- systems (WPIL) DERWENT PUBLICATIONS LTD., London * Abstract * & JP-A-63 175 670 (KANSAI PAINT KK) -----	1, 2	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 44 C C 09 D B 05 D
Place of search VIENNA		Date of completion of the search 24-10-1990	Examiner SCHÄFER
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			

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